ON THE EXCHANGE RATE RISK CONTRIBUTION TO THE PERFORMANCE OF INTERNATIONAL INVESTMENTS: THE CASE OF ROMANIA

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Abstract: *The paper examines the impact of changes in the Romanian currency exchange rates against the US dollar and the euro on an investment in the Romanian stock market from the perspective of a US dollar and euro based investor. Our analysis is directed towards identifying the significance of exchange rate volatility for the total risk of a Romanian investment from the perspective of investors with the US dollar and euro as reference currencies. Our results indicate that during more turbulent times investors were better off if invested in their home markets. We also find that the exchange rate risk decreased the risk that a US dollar or a euro-based investor was exposed to in Romania. The contribution of exchange rate risk to the risk of an international investor diversified in his home market and the Romanian market is small, even negative, with no significant differences turbulent versus normal times.*

Keywords: *Exchange rate, Romania, international investments, volatility*

JEL classification: *F21, F31*

1. INTRODUCTION[8]

International investments are equivalent to investing in two different assets: the first one is the foreign stock or portfolio and the second one is represented by the foreign currency. Therefore, the actual risk and returns obtained from investing abroad are linked not only to the risk and return of the foreign asset or portfolio, but also to the changes in the exchange rate between the foreign currency and the home or reference currency of the investor. As changes in the foreign asset prices impact the risk-return profile of the international investor, so is the case with changes in exchange rates. In a world dominated by floating exchange rates, the currency

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volatility impact on international investments outcome is by no means a minor issue. But evaluating this impact is not a simple exercise, as currency movements influence the volatility of an international investment not only directly, through their own volatility, but also through the link between foreign returns and exchange rate changes. The good news is that, sometimes, this link can actually decrease the total volatility of an investment made abroad, instead of magnifying it, as one may think at first sight.

In a framework of increasing international portfolio investments and of business opportunities diversification at the global level, but also of higher capital market integration, investors critically evaluate the exchange rate risk, particularly when investments are made in emerging markets. These markets are acknowledged to have higher levels of instability, compared to developed markets, and the crises that affected emerging countries in the 1990s, but also the current financial turmoil, have demonstrated that the negative impact of exchange rate fluctuations is seriously felt by international investors. In this context, various studies raised the issue of a "legitimate" risk premium associated to investments in foreign markets that would compensate investors for taking on higher risks than in their home markets.

Research on the links between stock market returns and exchange rate movements has developed since the beginning of the 1980s, with rather mixed evidence, depending on the methodology employed. One set of studies uses APT models to identify the exposure of national stock markets or various industries within a country to exchange rate fluctuations. Aggarwal (1981) is among the first researchers that study stock prices and exchange rates and he finds a significant relationship between the appreciating US dollar and US stock prices, but a few years later Soenen and Hennegar (1988) find an opposite relationship between the two variables. Jorion (1990) examines US multinational corporations exposure to exchange rate risk for a 17 years period and concludes that share prices of these companies are not systematically influenced by changes in nominal exchange rates. Bartov and Bodnar (1994) and Choi and Prasad (1995) confirm Jorion's findings, while Gao (2000) and Koutmos and Martin (2003) seem to detect a more significant link between the American companies share prices and changes in the nominal exchange rate of the dollar against various currencies. Besides US companies, Dutch companies have been researched by De Jong et al. (2002) that find more significant exposures in phases of the Dutch guilder depreciation, after investigating 117 companies over a 5-year period (1994-1998). Doukas et al. (2003) examine the relation between the rate of return of Japanese companies' shares and unexpected changes in the Japanese yen exchange rates between 1975 and 1995 and find significant exposures that positively linked to the degree of international involvement of the firm and negatively linked to the firm's size and its financial leverage. British companies also display significant exposure, according to El-Masry

(2003), but depending to a large extent on the industry. Kyimaz (2003) investigates Turkish companies for the period 1991-1998 and finds significant exposures to exchange rate risk, but also variable in magnitude from one industry to another.

For the Romanian market, Horobet and Lupu (2005) analyse the January 2000 – October 2005 period and find weak significant exposures of stock returns to the euro-leu and US dollar-leu exchange rate. Their findings may be explained by the reduced importance of the euro or dollar denominated cash flows and/or assets and liabilities in the financial flows of Romanian companies, by the possible presence of internal hedging operations or by the low capital market efficiency. Horobet and Lupu (2006) extend their analysis to ten CEE countries (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovenia, Slovakia and Romania) by taking into consideration changes in these countries' real exchange rates measured against the U.S. dollar and the euro. The results indicate the lack of contemporaneous and lagged exposures, which may be interpreted as a failure of stock market investors to incorporate changes in the competitive positions of firms in these countries in the stock returns. More recently, Horobet and Dumitrescu (2008) investigated the exposure of national stock markets from four countries in Central and Eastern Europe – Czech Republic, Hungary, Poland and Romania – to nominal and real exchange rate risk, using monthly data on exchange rates and stock market returns over the January 1999 – December 2007 timeframe. They find that companies from the region show contemporaneous and lagged exposure to nominal and real exchange rate risk and that these exposures are of the same type in all countries, suggesting a similarity in the economic structure in terms of foreign operations activity – exporting versus exporting. Romania is the country where the evidence for exposure is mostly limited, indicating a lower market efficiency and a poorer understanding from the part of capital market investors of Romanian companies operations.

The other direction of research on the study of the interrelationships between stock prices and exchange rates was developed through the use of cointegration and Granger causality tests to study the dynamic and bi-directional relation between exchange rates and stock prices. Kim (2003) investigates the existence of long-run equilibrium relationships among the aggregate stock price, industrial production, real exchange rate, interest rate and inflation rate in the United States, applying Johansen's cointegration methodology and he finds that for the 1974-1998 period the S&P 500 index is positively related to the industrial production but negatively related to the other variables. Dong et. al (2005) examine six emerging Asian countries over 1989 and 2003 and find no cointegration between their exchange rates and stock prices, but they detect bi-directional causality in Indonesia, Korea, Malaysia and Thailand. Except for Thailand, the stock returns show significantly negative relation with the contemporaneous change in the exchange rates, which

implies that currency depreciations generally accompany falls in stock prices. Ibrahim (2000) studies the interactions between the foreign exchange market and the stock market in Malaysia and his results indicate that despite the lack of a long-run relationship between the exchange rate measures and stock prices in bivariate cointegration models, there is evidence of such long-run relations in multivariate models that include money supply and foreign reserves. Murinde and Poshakwale (2004) investigate price interactions between the foreign exchange market and the stock market in three European emerging financial markets – Hungary, Poland and Czech Republic – before and after the adoption of the euro. Using daily observations on both stock prices and exchange rates, they find that for the pre-euro period stock prices in these countries uni-directionally Granger cause exchange rates only in Hungary, while bi-directional causality relations exist in Poland and Czech Republic. After the euro adoption, exchange rates uni-directionally Granger-cause stock prices in all three countries. The authors interpret these results as being consistent with the dynamic nature of the transition process, suggesting that causality is much easier to detect as the markets become more integrated with the EU. Horobet and Ilie (2007) study the Romanian market using cointegration and Granger causality tests applied to monthly data over the 1999-2007 period and conclude that there is a long-term equilibrium relationship between the stock market performance and the nominal and real effective exchange rates of the Romanian currency, but the information is generally transmitted from the stock prices to exchange rates with a one-month lag in the case of cointegrated variables. The exchange rates are the leading variables for the stock prices and the stock market adjusts quite dramatically to changes in the exchange rates in one month time.

In this paper, we examine the impact of changes in the Romanian currency – leu – exchange rates against the US dollar and the euro on an investment in the Romanian stock market from the perspective of a US dollar and euro based investor. Our analysis is directed towards identifying the significance of exchange rate volatility on the total risk of a Romanian investment from the point of view of two potential investors having the US dollar and the euro as reference currencies. At the same time, we aim at discovering the contribution that currency risk makes to the correlation between the Romanian stock market returns, on one hand, and US market and European markets, on the other hand. The correlation between international markets is an important building block of the risk associated to an international portfolio of assets and we are particularly interested in examining it in normal conditions as well as in times of financial turbulences.

The paper is structured as follows. Section 2 explains the sources of currency volatility contribution to the risk-return outcome of an international investment, Section 3 examines the evolution of the Romanian currency after the introduction of the euro in 1999 and discusses its significance from the perspective of a foreign

investor present in the Romanian market, Section 4 presents the data and the methodology employed in this study, Section 5 discusses the results and Section 6 concludes.

2. CURRENCY RISK AND THE RISK-RETURN PROFILE OF INTERNATIONAL INVESTMENTS

The evolution of exchange rates represents nowadays a major source of concern from both a micro- and a macroeconomic perspective, given the cvasi-generalised adoption of floating rates since 1973. The exchange rate is one of the most synthetic prices in an economy and it can be thought as the expression of a general equilibrium among the market for real goods and services, the money market and the capital market, which has the obvious potential of influencing the general economic equilibrium in any economy. The exchange rate behaviour is influenced, at its turn, by the degree of economic growth, the changes in the general level of prices (inflation), the industry structure of the economy, the country's level of international competitiveness and its degree of trade and financial openness, the political stability and governments' ability to solve internal crises which might occur. This diversity of factors that impact directly or indirectly the exchange rate raises the issue of the easiness of managing such a complex and dynamic macroeconomic variable. The choice of an optimal exchange rate regime is an unresolved question of international macroeconomics, as the history of international finance shows. From the band fixed exchange rates in the '40s, '50s and '60s, countries have gradually moved towards more flexibility in their exchange rates, but a number of "intermediate regimes" have been employed at the international level with the aim of better accommodating a country's specificity with the exchange rate policy. Nevertheless, the currency crises that occurred in the last two decades have generated a growing support for clear cut exchange rate regimes – such as hard pegged rates or free floating rates -, considered more appropriated in the current framework of higher financial integration fuelled by unprecedented capital mobility at the global level.

The impact of exchange rate fluctuations is felt at the level of risk and return for any investment made abroad, in a different currency than the reference currency of the investor. Jorion (1985) , Levy and Lim (1994), Eun and Resnick (1994) and, more recently, Bugar and Maurer (2002) have shown that investors that do not control for the uncertainty associated to exchange rate movements are in the difficult position of obtaining gains from international investments that are not able to exceed the costs attached to holding assets abroad. The explanation resides in the correlations between exchange rates, which are not small enough to provide investors with enough input for achieving good diversification in an international portfolio.

The rate of return that an investor obtains from holding a foreign asset can be decomposed in three parts: the income provided by any cash flows received during the holding period ($CF_{t-1/t}$), the capital gain or loss provided by the changes in the price of the foreign asset and the currency gain or loss. Specifically,

$$r^{HC} = \left[1 + \frac{(P_t^{FC} - P_{t-1}^{FC}) + CF_{t/t-1}^{FC}}{P_{t-1}^{FC}}\right] \times (1+s) - 1 \quad (1)$$

where, P_t^{FC} and P_{t-1}^{FC} denote the prices in the local currency of the foreign asset at moments *t* and *t-1*, respectively,

$CF_{t/t-1}^{FC}$ is the cash flow provided by the foreing investment, also in the local currency (it can be either a dividend or an interest), and *s* is change in the exchange rate of the foreign currency against the home currency of the investor.

Equation (1) may be re-written in the following manner:

$$r^{HC} = r^{FC} + s + (r^{FC} \times s) \quad (2)$$

where, r^{HC} is the return in the home currency of the investor,

r^{FC} is the return of the investment in the foreign asset in local currency terms, and s is the change in the exchange rate between the two curencies.

Since typically the product $(r^{FC} \times s)$ takes small values, it is ignored for most computations of the return and risk.

One may easily observe that exchange rate changes have the potential of either increasing of decreasing the return that is finally available to an investor: when the foreign currency appreciates against the home currency of the investor, this magnifies the return in the foreign currency; the reverse is true in case of a depreciation of the foreign currency against the currency relevant to the investor.

The risk of an asset is also different when measured in different currencies. If we ignore the cross-product $(r^{FC} \times s)$, we can prove that the variance of a return measured in the home currency of the investor equals the variance of the sum of the local currency return and of the exchange rate movement:

$$\text{var}(r^{HC}) = \text{var}(r^{FC} + s) = \text{var}(r^{FC}) + \text{var}(s) + 2\,\text{cov}(r^{FC}, s) \quad (3)$$

or

$$\text{var}(r^{HC}) = \text{var}(r^{FC}) + \text{var}(s) + 2corr(r^{FC}, s)\sigma(r^{FC})\sigma(s) \quad (4)$$

where, $\text{var}(r^{HC})$ is the variance of the return measured in the home currency of the investor,

$\text{var}(r^{FC})$ is the variance of the return measured in the foreign currency,

$\text{var}(s)$ is the variance of exchange rate changes,

$\text{cov}(r^{FC}, s)$ is the covariance between the return in the foreign currency and exchange rate changes,

$corr(r^{FC}, s)$ is the correlation between the return in the foreign currency and exchange rate changes,

$\sigma(r^{FC})$ is the standard deviation of return measured in the foreign currency and

$\sigma(s)$ is the standard deviation of exchange rate changes.

As the correlation is never greater than 1, the foreign asset risk and the currency risk are no additive, and we can prove that

$$\sigma(r^{HC}) \leq \sigma(r^{FC}) + \sigma(s) \tag{5}$$

The difference between $\sigma(r^{HC})$ and $\sigma(r^{FC})$ is called the contribution of currency risk to the risk of an international investment and we may demonstrate that it largely depends not only on the exchange rate volatility, but also on the link between the exchange rate and the foreign asset returns.

There are a few points to mention for what concerns the overall impact of currency risk on an international investment. First, currency fluctuations affect both the total return and the volatility of any foreign-currency denominated investment and, from time to time, the effects of currency fluctuations on the investment return may exceed that of capital gain or income, especially over short periods of time. At the same time, empirical studies indicate that currency risk, as measured by the standard deviation of the exchange rate movement, is smaller than the risk of the corresponding stock market. Second, the exchange risk of an investment may be hedged for major currencies by selling futures or forward currency contracts, buying put currency options, or even borrowing foreign currency to finance the investment, therefore currency risk can be easily eliminated in international investment strategies and does not represent a definite obstacle for international investments. Third, the contribution of currency risk should be measured for the total portfolio rather than for individual markets or securities, because part of that risk gets diversified away by the mix of currencies represented in the portfolio, as Biger (1979), Giovannini and Jorion (1989) and Harvey et al. (2002) show. Fourth, the contribution of currency risk decreases with the length of the investment horizon, so an investor with a long time horizon should care less about currency risk than should an investor who is concerned about monthly fluctuations in the portfolio's value. For example, Froot (1993) shows that for a horizon of more than one decade currency risk is irrelevant to an international investor.

3. ROMANIAN CURRENCY EXCHANGE RATES: 1999-2009

The enlargement of the European Union in May 2004, by the accession of ten Central and South-Eastern European countries, of which eight were former communist countries (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia), followed by a second wave of accession at the beginning of 2007, that also involved two former communist countries (Bulgaria and Romania), represents an economic and political experiment that is entirely different from all previous accessions. The differences stem not only from the diversity of these countries in terms of culture, population size, territory dimension, but also from the macroeconomic specificity of the region. It is obvious the fact that the integration process of all these countries will directly impact their money and currency markets, with a precise goal represented by the adoption of the common euro currency. The adoption of the euro is by far the greatest challenge all these countries were faced with since the moment of their accession to EU, and one of these countries – Slovenia – proved that the criteria imposed by the EU in order to adopt the euro can be achieved, as the country adopted the euro as its currency at the beginning of 2007.

At present, the exchange rate regimes of countries from Central and Eastern Europe are rather diverse, but this diversity may be explained by the structural diversity of the group and by their need to actively control inflation and exchange rates (see Table 1). In the past ten years, five of the CEE emerging economies changed their monetary policy rule by adopting the inflation targeting regime: the Czech Republic in 1998, Poland in 1999, Hungary in 2001 and Romania in 2005. All these countries will see their currencies replaced by the Euro, but not before spending at least two years in the ERM II. This multilateral exchange rate arrangement was put in place on January 1st, 1999, with the purpose of ensuring the convergence of the economies that were participating in the system. The final goal is a smoother adoption of the Euro, by inducing higher stability of exchange rates against the Euro. Joining ERM II presupposes the establishment of a fixed exchange rate of the respective currency against the Euro with a variation margin of ±15%. The countries currently engaged in ERM II are Denmark (with a margin of only ±2,5%) and Lithuania, Estonia and Latvia (all with a margin of ±15%). In reality, the effective margins followed by these currencies are smaller: the Danish krone operates at a margin lower than 1%, the Latvian lats at a 1% margin, while the Estonian kroon and the Lithuanian litas have 0% margins. This indicates a higher commitment of the central banks in these countries to ensure the highest possible level of stability of exchange rates against the Euro.

Table 1 *Exchange rate regimes in CEE countries*

Country	*Currency*	*Exchange rate regime*	*ERMII participation since*
Czech Republic	Koruna (CZK)	Traditional administered floating	NO
Hungary	Forint (HUF)	Exchange rate varies with the Euro within ±15%	NO
Poland	Zloty (PLZ)	Independent floating	NO
Romania	Leu (RON)	Managed floating	NO
Slovenia	Tolar (SIT)	Euro	2004
Slovakia	Koruna (SKK)	Managed floating	2006
Latvia	Lats (LVL)	Exchange rate fixed to currency basket	2005
Lithuania	Litas (LTL)	Monetary council	2004
Estonia	Koruna (EEK)	Monetary council	2004

Source: *IMF, European Central Bank*

In Romania, the exchange rate policy implemented since 1997 is the managed floating, with no obligation officially assumed by the Central Bank (National Bank of Romania) to intervene in the foreign exchange market for specifically defending an exchange rate of the domestic currency against a foreign currency or a basket of currencies. First, the US dollar was used as a reference currency, but after the introduction of the euro in 1999 the US dollar was replaced by a currency basket formed of the US dollar (40%) and the euro (60%) until 2003. The basket suffered successive alterations: in January 2004 the euro's weight in the basket was increased to 75% and the US dollar weight dropped to only 25%, and since November 2004 the reference basket was fully replaced by the euro, which is now the reference currency for the leu. Still, this does not imply a peg of the leu against the euro, as one may be inclined to believe at first sight.

Figure 2 and Figure 3 show the evolution of the Romanian currency against the euro and the US dollar in terms of end-of-month values of exchange rates from January 1999 until June 2009 (both exchange rates are denominated in domestic currency units per one unit of foreign currency). In order to have a better view on the trend of exchange rate fluctuation we have adjusted the time series by applying the Hodrick-Prescott filter (HPTrend in Figures 1 and 2). The Hodrick-Prescott filter is a smoothing method that is widely used for obtaining a smooth estimate of the long-term trend component of a series of data. The method was first proposed by Hodrick and Prescott (….) for postwar U.S. business cycles. The tool uses a two-sided linear filter that computes the smoothed series *s* of a series *y* by minimizing the variance of *y* around *s*, subject to a penalty parameter λ that constrains the second difference of *s*. The Hodrick-Prescott (HP) filter minimizes

$$\sum_{t=1}^{T}(y_t - s_t)^2 + \lambda \sum_{t=2}^{T}\left((s_{t+1} - s_t) - (s_t - s_{t-1})\right)^2$$

The parameter λ controls the degree of smoothness of the series variance: the larger the value of λ, the smoother the variance. When λ=∞, *s* approaches a linear

trend. We have used 14400 as the value of λ, suggested by E-views as appropriate for the work on monthly data.

Both figures show the relatively similar evolution of the Romanian currency exchange rate: a rather abrupt and predictable depreciation against the euro (until the end of 2004) and the US dollar (until the beginning of 2004), followed by a reversed trend of an appreciating RON until the beginning of 2007 (against the euro) and the end of 2007 (against the US dollar), with the subsequent period of again depreciating RON against both currencies until today. An interesting feature of both exchange rates is their increased volatility that accompanied the change in trend since 2004, fuelled by a higher volume of transactions in the Romanian foreign exchange market, particularly in the interbank market) and the less frequent but more massive interventions of the Central bank in the market.

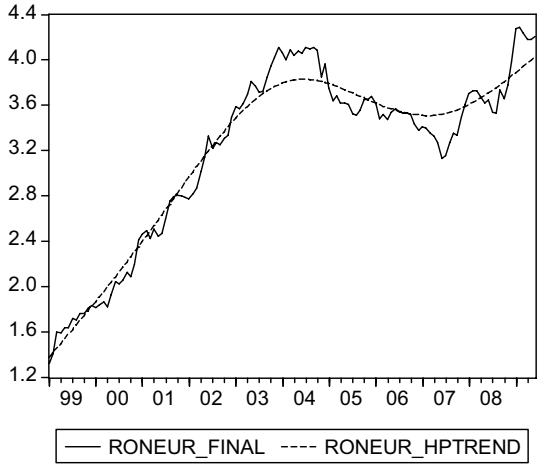

Figure 2 *Monthly RON-EUR exchange rate – observed values and HP filter, January 1999-June 2009*

As the results from Table 2 indicate, the volatility of both exchange rates was fluctuating from one year to the other, but we may notice high values for 1999, 2000, 2001 and then 2004. In 2005, 2006 and 2007 the monthly and annual volatilities dropped, but they returned to high values in 2008. Another view over the volatility in exchange rates is offered by Figure 4, which shows the rolling 12-month standard deviations for the RON-EUR and RON-USD exchange rates. Three features are interesting, in our view, as they emerge from Figure 4: first, the volatility of the RON-EUR exchange rate exceeded the volatility in the RON-USD exchange rate until July 2003, afterwards the RON-USD volatility was higher and it remained higher until end 2008; second, there are three peaks in volatility for the RON-EUR exchange rate: the first one starts at end 2000 and ends at beginning of 2002, the second one covers the year 2005 and the last one is observable towards the end of 2008; third, the RON-USD exchange rate also shows only peaks in volatility: the first one in 2005, matching almost fully the RON-EUR volatility peak and the second one at end 2007 and beginning 2008, with some prolongation over 2008.

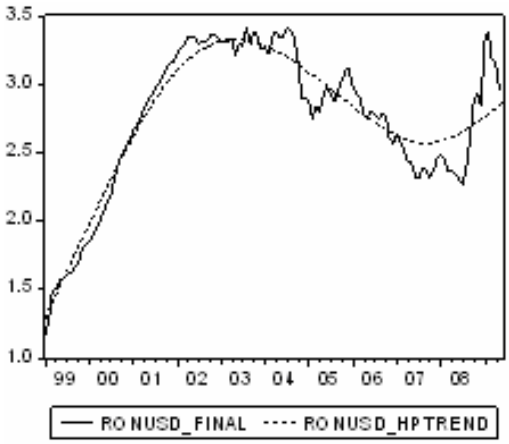

Figure 3 *Monthly RON-USD exchange rate – observed values and HP filter, January 1999-June 2009*

Table 2 *RON exchange rate volatility, 1999-2008*

	Average monthly standard deviation of exchange rate changes		*Annual standard deviation of exchange rate changes*	
	RON - EUR	*RON - USD*	*RON - EUR*	*RON - USD*
1999	0.0395	0.0451	0.1368	0.1561
2000	0.0343	0.0098	0.1188	0.0341
2001	0.0267	0.0052	0.0926	0.0182
2002	0.0256	0.0106	0.0886	0.0366
2003	0.0172	0.0241	0.0595	0.0836
2004	0.0273	0.0341	0.0945	0.1181
2005	0.0162	0.0313	0.0560	0.1084
2006	0.0161	0.0259	0.0557	0.0897
2007	0.0264	0.0273	0.0914	0.0945
2008	0.0330	0.0622	0.1144	0.2154

Note: Annual standard deviation values are obtained from monthly standard deviations values multiplied by $\sqrt{12}$.

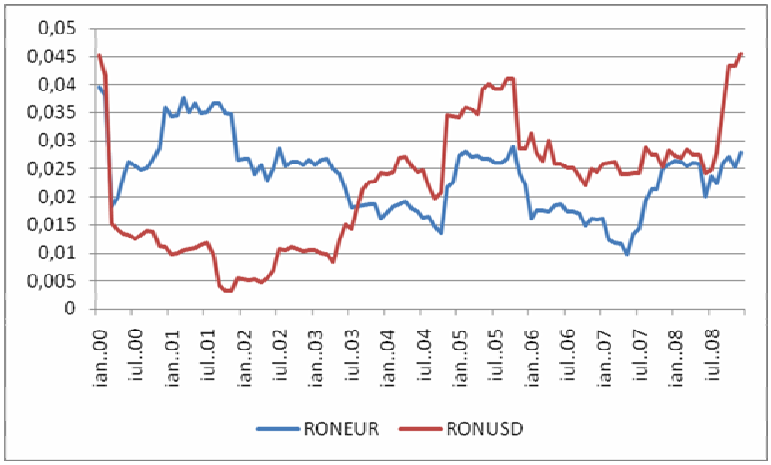

Figure 4 *Rolling monthly standard deviations of changes in the RON-EUR and RON-USD exchange rates*

Note: The figure shows the rolling 12-month standard deviations in the RON-EUR and RON-USD exchange rates, with the first observation, January 2000, indicating the standard deviation of logarithmic changes in the exchange rate for the twelve previous month.

As mentioned above, one of the reasons for the increased volatility of exchange rates relies in the volume of transactions in the Romanian foreign exchange market. Although its volume is still at low levels compared to mature foreign exchange markets, Figure 5 shows a marked increase in the volume of transactions starting from mid-2005, as compared to the previous period: in January 2000, the transactions in the foreign exchange market were only of 85.78 million euro, while in June 2009 the volume reached 1,334.00 million euro, with a peak of 2,572.00 million euro in October 2008. The new structural characteristics of the Romanian foreign exchange market make it appropriate for high volatility: (1) the market has the lowest volume as compared to the markets of other emerging countries in the region[9]; (2) most operations in the market are of a very short maturity[10]; (3) financial derivatives has the lowest share in the market, which makes the hedging of exchange rate risk a difficult endeavor; (4) non-residents investors hold 90% of the derivatives market.

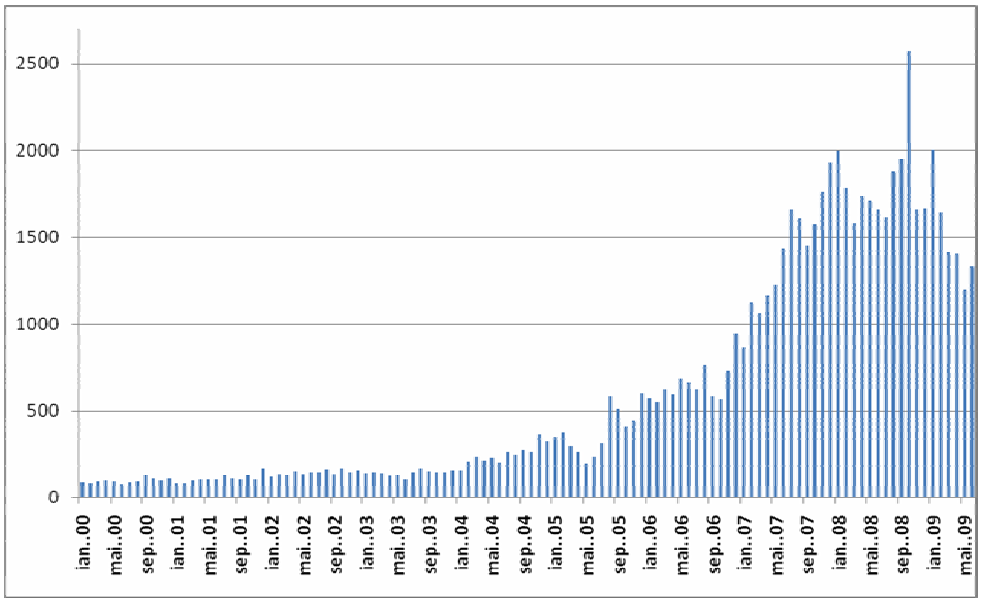

Figure 5 *Romanian foreign exchange market: Volume of transactions, million euro*
Source*: National Bank of Romania database*

The central bank position in the foreign exchange market changed from a net seller of foreign currencies before 2002 to a net purchaser until present. This change was in line with the National Bank of Romania's objectives established at the end of 2000: the consolidation of the official reserves, a preventive action against an excessive appreciation of the domestic currency and a gradual disinflation process.

[9] According to BIS Triennial Central Bank Survey 2007, the average daily volume of transactions in the foreign exchange market in April 2007 was 2,510 million USD in Romania, 3,362 million USD in Turkey, 4,947 million USD in Czech Republic, 6,715 million USD in Hungary and 8,813 million USD in Poland.

Due to the apparent contradiction between these objectives, the central bank chose two instruments for attaining them. Aiming at consolidating reserves and at limiting the real appreciation of the domestic currency in an attempt to support the Romanian products' export competitiveness, the central bank purchased impressive amounts of foreign currencies that were able to cover more than four months of imports at end 2004 and six months at end of 2007. The high accumulation of reserves contributed to the decrease of Romania's country risk and the increase in the country's rating, which in turn generated an improved acces to external financing. At the same time, this access to external funds was accompanied by the fight against the nominal and real appreciation of the domestic currency. When, at end 2003, the central bank diminished the pace of foreign currencies' purchases, the RON slightly appreciated against the reference basket.

In October 2004 the central bank decided to reduce the frequency of its interventions in the foreign exchange market and to make them more massive and less predictable. The goal was to induce a higher volatility in the exchange rate which would descourage substantial short-term capital inflows in the Romanian economy. In only a few months, the RON nominal exchange rate against the euro reached a value of 38.49 RON/EUR, which represented an appreciation of 6.4% of the Romanian currency compared to its value of 41.127 RON/EUR in October 2004. In March 2005 the exchange rate was 36.422 RON/EUR, indicating a further appreciation of 5.68% of the domestic currency against the euro. The evolution came as a surprise for Romanian economic operators, accustomed with a depreciating currency and rather predictable exchange rates.

In 2005, the National Bank of Romania adopted a new monetary rule, inflation targeting, accompanied by the (almost) full capital account liberalization and the domestic currency denomination. At the end of 2005, the inflation rate, which decreased dramatically since 1999, reached 8.6 per cent, a value that is slightly higher than the extended band of 7.5 per cent ±1 per cent, but it is worth mentioning that the central bank has to face during the year the issue of economy overheating and of soaring capital inflows fuelled by high interest rates in the banking market.

In 2006, the domestic currency appreciated by over 8 percent against the euro and nonredisedents started to become major contributors to the transactions in the foreign exchange market. The volume of average daily transactions due to nonresidents grew almost four times in 2006 compared to 2005, exceeding the transactions performed by residents. The evolution was due to high returns in RON-denominated assets determined by the capital account liberalization, the country's

[10] According to the same BIS Survey, in April 2007, 81% of transactions in the Romanian foreign exchange market had a maturity of less than seven days, compared to 58% in the Czech Republic and 52% in Turkey.

anticipated joining of the European Union and favourable conditions in the international financial markets. 2007 was a year of high volatility in the foreign exchange market, with evolutions in the exchange rate of the RON that considerably reduced the predictability of decisions at micro- and macroeconomic level. During the first semester of the year, the domestic currency appreciated by 8 percent in nominal terms against the euro, and was followed by a sharp depreciation between August 2007 and March 2008 (18% against the euro). The volatility in the exchange rate reached the highest level in November 2007, when Standard & Poor's upgraded the credit rating of the country from "stable" to "positive", which raised concerns in the market regarding a possible important correction of the RON value. The depreciating trend of the RON in the first part of 2008 continued in the second part of the year and until mid-2009, which severly inflicted the operators' reaction ability to the global turbulences. Besides the global factors that generated this evolution, mainly related to the high uncertainty associated to the state of the global financial system and the possible repercussions at the level of emerging markets, the worsening of Romania's credit credit played undoubtedly a role in the RON movements. During this period, the central bank interventions in the foreign exchange market aimed at reducing the excessive variations in the exchange rates of the RON, but they were made more difficult by the significant decrease of market liquidity, due to fund withdrawals by nonresidents[11].

The crisis that emerged at the international level in 2008 hit Romania forcefully. There are five main channels that assist the propagation to the crisis to Romania[12]: (1) the foreign trade, through the low share of exports in Romanian GDP – only 24% at end 2008, compared to more than 60% for other countries in Central and Eastern Europe; (2) the confidence level of residents and nonresidents, reflected in high risk aversion and decline in foreign direct investments; (3) the wealth and balance sheet; (4) the dependency of Romanian banks on foreign financing, coupled with the high debt service share in GDP (25.4%); (5) the exchange rate, affected by low capital inflows and significant depreciation pressures. The perspectives for the Romanian currency at the end of 2009 and 2010 are not optimistic. In their most recent quarterly report[13], UniCredit analysts estimate an exchange rate of the domestic currency of 4.50 against the euro for the end of 2009 and of 3.10 against the US dollar, but, at the same time, the forecasts for 2010 and 2011 are more optimistic: an exchange rate of 4.28 RON/EUR and 3.14 RON/USD for end of 2010 and of only 4.00 RON/EUR and 2.96 RON/USD for end of 2011. The Government

[11] In November 2008, the volume of transactions in the Romanian foreign exchange market diminished by 60% against the previous month, which market the debut of a decrease in foreign exchange activity until April 2009.

[12] Isărescu, M.– "The Global Financial Crisis, Bail-outs and Bail-ins", Presentation at Central & South East European Financial Forum, 19-22 May 2009, Bucharest

[13] UniCredit Group – "CEE Quarterly Report", 3/2009

took into account an average 4.00 RON/EUR for the 2009 budget plan and 4.09 RON/EUR for end of December 2010.

4. DATA AND METHODOLOGY

We use daily data on stock indices and exchange rates. We employ three stock market indices, to capture the performance of the Romanian market, the US market and the European market. All indices are collected from the Morgan Stanley Capital International Database in Romanian lei (RON), US dollars (USD) and euros (EUR), respectively. The exchange rates are collected from the National Bank of Romania time series database and refer to the Romanian leu against the US dollar and the euro. The following time series are calculated from the data for our research: logarithmic rates of return in local currencies, logarithmic rates of return in US dollars and euros, exchange rates changes, measures of market correlations.

The analysis covers the period starting on December 26, 2007 and ending on August 4, 2009. The period is split in two equal parts around the date of October 15, 2008, considered the day when the current financial crisis intensified. The day was chosen as it recorded the largest daily drop in the value of the MSCI US index since 1999 – more precisely, the change in the index value was -9.51% . The analysis on these two sub-periods allows us to observe into more detail whether in times of financial instability the importance of currency risk for an international investor changes as compared to more stable periods. Each of the two sub-periods in again split in ten equal intervals of 20 observations, aiming at studying the time-varying attributes of stock market returns and risks, currency volatility and correlations.

To measure the extent to which the Romanian market volatility and correlations with the US and European markets are influenced by exchange rate fluctuations, we first decompose the US dollar and euro returns obtained in the Romanian market as following:

$$r_t^{HC} = \ln P_t^{RON} S_t^{HC/RON} - \ln P_{t-1}^{RON} S_{t-1}^{HC/RON} = \ln(P_t^{RON} - P_{t-1}^{RON}) - \ln(S_t^{HC/RON} - S_{t-1}^{HC/RON}) \\ = r_t^{RON} + s_t^{HC/RON} \quad (6)$$

where, r_t^{HC} is the return in the Romanian market denominated in the home currency of the investor,

P_t^{RON} is the Romanian stock market index at time t, denominated in RON,

r_t^{RON} is the RON denominated return in the Romanian stock market at time t/t-1,

$S_t^{HC/RON}$ is the exchange rate of the Romanian currency against the US dollar and the euro, respectively, and

$s_t^{HC/RON}$ is the exchange rate fluctuation of the Romanian currency relative to the US dollar and the euro at time t/t-1. HC is represented by the US dollar and the euro.

Equation (6) shows that the return obtained from a US investor in the Romanian market index is composed of the return in RON (local currency) and the exchange rate fluctuation. The same is true for the return obtained by a euro-based investor.

Moving to the risk of an investment made in the Romanian market, we compute the variance of returns as in equation (3), as follows:

$$\text{var}(r^{HC}) = \text{var}(r^{RON}) + \text{var}(s^{HC/RON}) + 2\,\text{cov}(r^{RON}, s^{HC/RON}) \qquad (7)$$

The proportion of the volatility of Romanian returns denominated in HC (US dollar and euro, respectively) attributable to exchange rate fluctuations that we denote by λ, can be computed as the following:

$$\lambda = \frac{\text{var}(s^{HC/RON}) + 2\,\text{cov}(r^{RON}, s^{HC/RON})}{\text{var}(r^{HC})} = 1 - \frac{\text{var}(r^{RON})}{\text{var}(r^{HC})} \qquad (8)$$

Equation (8) shows that the proportion of Romanian market volatility that is explained by changes in the Romanian currency exchange rate against the US dollar or the euro depends not only on the volatility present in the foreign exchange market, but also on the covariance of the Romanian stock market returns and exchange rate changes. This implies that exchange rate volatility will not necessarily induce more volatility in the returns availble to foreing investors, due to the value and sign of the covariance. The contribution of exchange rate volatility to the risk beared by a foreign investor in the Romanian market depends on the ratio between the covariance and the variance of exchange rate changes. More specifically, if $\frac{\text{cov}(r^{RON}, s^{HC/RON})}{\text{var}(s^{HC/RON})} > -0.5$ exchange rate fluctuations represent an additional sources of risk for the investors. Conversely, if $\frac{\text{cov}(r^{RON}, s^{HC/RON})}{\text{var}(s^{HC/RON})} \leq -0.5$ exchange rate fluctuations do not contribute to the volatility of returns in the home currency of the investor. We observe the evolution of λ for the entire period, the two sub-periods and each of the ten intervals in the sub-periods.

Besides on the interest a foreign investor might have in investing in the Romanian market per se, it would be also relevant for him to analyze the contribution that exchange rate risk has on the correlation between the Romanian market and his home market, presuming his aspiration to diversify the risk in his home market by investing abroad. We study this contribution starting from the

correlation coefficient between the return in the Romanian market denominated in the home currency of the investor, r_t^{HC}, and the return obtained by the investor in his home market, denominated in home currency units, r_t :

$$\begin{aligned}\rho(r_t^{HC}, r_t) &= \frac{\text{cov}(r_t^{HC}, r_t)}{\sigma(r_t^{HC}) \times \sigma(r_t)} = \frac{\text{cov}((r_t^{RON} + s_t^{HC/RON}), r_t)}{\sigma(r_t^{HC}) \times \sigma(r_t)} \\ &= \frac{\text{cov}(r_t^{RON}, r_t) + \text{cov}(s_t^{HC/RON}, r_t)}{\sigma(r_t^{HC}) \times \sigma(r_t)} = \frac{\text{cov}(r_t^{RON}, r_t)}{\sigma(r_t^{HC}) \times \sigma(r_t)} + \frac{\text{cov}(s_t^{HC/RON}, r_t)}{\sigma(r_t^{HC}) \times \sigma(r_t)}\end{aligned} \quad (9)$$

Equation (9) shows that the exchange rate volatility influences the correlation between the two markets' returns, and its effective contribution to the correlation, denoted by φ, can be computed as follows:

$$\begin{aligned}\phi &= \frac{\text{cov}(s_t^{HC/RON}, r_t)}{\sigma(r_t^{HC}) \times \sigma(r_t)} \div \rho(r_t^{HC}, r_t) = \frac{\rho(s_t^{HC/RON}, r_t) \times \sigma(s_t^{HC/RON}) \times \sigma(r_t)}{\rho(r_t^{HC}, r_t) \times \sigma(r_t^{HC}) \times \sigma(r_t)} \\ &= \frac{\rho(s_t^{HC/RON}, r_t) \times \sigma(s_t^{HC/RON})}{\rho(r_t^{HC}, r_t) \times \sigma(r_t^{HC})}\end{aligned} \quad (10)$$

Equation (10) allows us to observe that for given values of $\rho(r_t^{HC}, r_t)$, the values of φ depend on the correlation between HC market returns with the change in the exchange rate of the HC against the RON and the ratio between the exchange rate volatility and the volatility of the Romanian market return denominated in the HC of the investor. As in the case of λ, we observe the evolution of φ for the entire period, the two sub-periods and each of the ten intervals in the sub-periods.

5. RESULTS

Figure 6 and Figure 7 show the performance obtained by an investment of 100 units made in December 26, 2007 until August 4, 2009, in US dollars and euros. For a US dollar based investor, an investment in a portfolio such as MSCI Romania brought returns rather similar with an investment in MSCI US until August 2008, but afterwards the performance of MSCI US was better than the performance of MSCI Romania denominated in US dollars. The main explanation behind this performance relies in the depreciation of the Romanian currency against the US dollar in the second sub-period in our analysis. Overall, at the end of period, an investment of 100 at the beginning of the period would have brought the US investor with a loss of 32.53% if invested in the US index and of 44.41% when invested in the Romanian index. Interestingly, at the end of the first sub-period, the losses were similar for the US based investor: 33.48% for MSCI US and 41.89% for MSCI Romania.

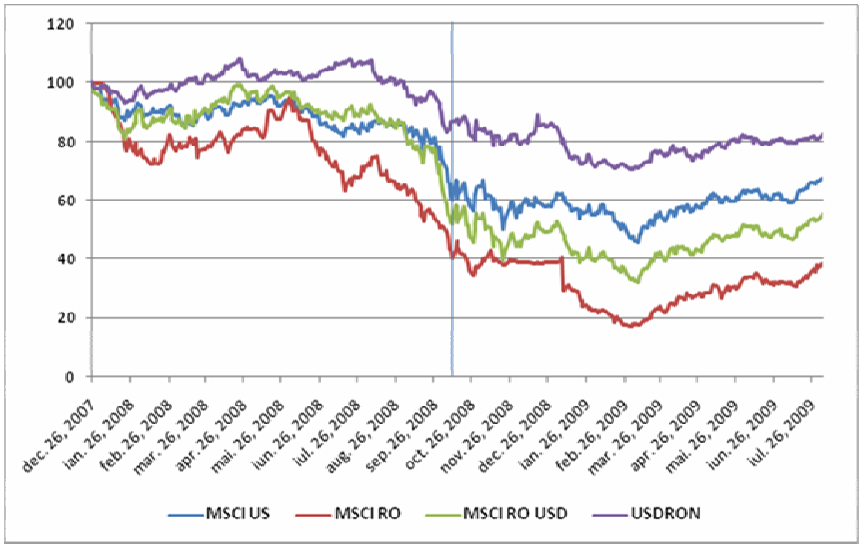

Figure 6 *Market indices and USD-RON exchange rate*

A similar framework is encountered in the case of a euro-based investor: an investment in a portfolio such as MSCI EMU brought returns rather similar with an investment in MSCI Romania until October 2008, but afterwards the performance of MSCI EMU was better than the performance of MSCI Romania denominated in euro. The main explanation behind this performance relies, again, in the depreciation of the Romanian currency against the euro in the second sub-period in our analysis. Overall, at the end of period, an investment of 100 at the beginning of the period would have brought the eurozone investor with a loss of 40.67% if invested in MSCI EMU and of 51.13% when invested in the Romanian index. At the end of the first sub-period, the losses were also similar: 38.59% for MSCI EMU and 43.48% for MSCI Romania. The analysis suggests that during more turbulent times, as the ones recorded in the second sub-period, investors were better off if invested in their home markets, as compared to the Romanian market, when they are also hit by changes in the exchange rates.

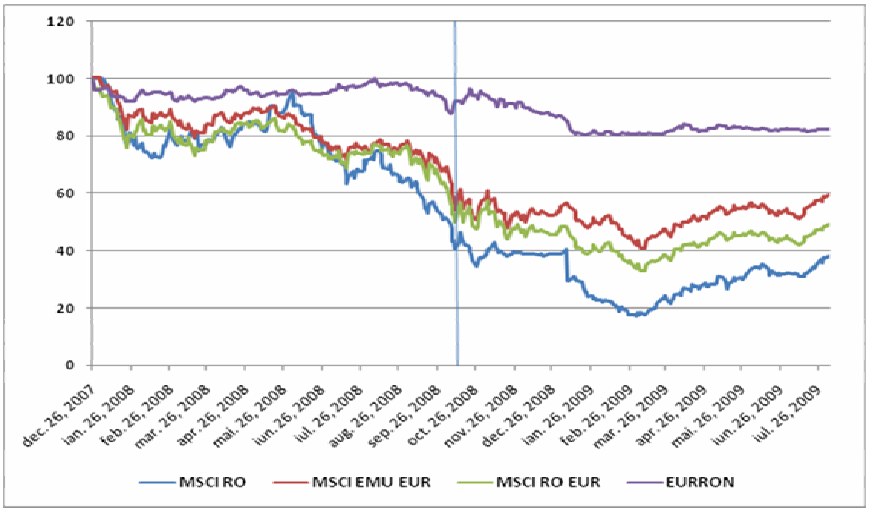

Figure 7 *Market indices and EUR-RON exchange rate*

Another perspective on the performance of the two investment strategies (investing at home or abroad) is provided by Table 3 for the US dollar based investor and by Table 4 for the euro based investor. In US dollar terms, the daily mean return over the entire period was slightly negative (-0.09%) for MSCI US, which was better than the return provided by an investment in the Romanian market (-0.23%) in RON, and the one in the Romanian market converted in USD (-0.14%). Also, the volatility of an investment in the US market was lower than the one in the Romanian market in RON or USD: 2.35% compared to 3.09% and 2.69%, respectively. When we split the analysis into the two-subperiods, the results, although different in numbers, are similar: the investment in MSCI US brought higher mean average returns in both sub-periods and lower standard deviations compared to the investment in MSCI Romania. Interestingly, though, the mean return for the second sub-period is slightly higher than the mean return for the first sub-period, which may be explained by the timid recovery of stock markets in the first part of 2009.

Table 3 *Descriptive statistics of stock market and exchange rate returns – USD denominated*

	MSCI US - USD	MSCI RO RON	USDRON	MSCI RO - USD
Overall period				
Mean return	-0.0009	-0.0023	-0.0005	-0.0014
Standard deviation	0.0235	0.0309	0.0117	0.0269
Skewness	-0.0762	-2.6882	-0.3390	-0.2799
Excess kurtosis	3.6902	27.1031	2.5179	2.8838
First sub-period				
Mean return	-0.0019	-0.0037	-0.0006	-0.0026
Standard deviation	0.0195	0.0241	0.0097	0.0213
Skewness	0.0919	-0.2896	-0.7578	-0.2263
Excess kurtosis	7.9230	1.4269	2.7484	8.0002
Second sub-period				
Mean return	0.0001	-0.0010	-0.0003	-0.0002
Standard deviation	0.0270	0.0365	0.0135	0.0315
Skewness	-0.1902	-3.2684	-0.1886	-0.3422
Excess kurtosis	1.8865	28.0825	1.8585	1.0510

For a euro-based investor, the results do not significantly differ from the US dollar investor: overall, the daily mean return over the entire period was slightly negative (-0.12%) for MSCI EMU, higher than the return provided by an investment in the Romanian market (-0.23%) in RON, and the one in the Romanian market converted in euros (-0.17%). The volatility of an investment in MSCI EMU was lower than the one in the Romanian market in RON or USD: 2.13% compared to 3.09% and 2.31%, respectively. When we split the analysis into the two-subperiods, the results, are again similar: the investment in MSCI EMU brought higher mean average returns in both sub-periods and lower standard deviations compared to the investment in MSCI Romania. In this case too, the mean return for the second sub-period is slightly higher than the mean return for the first sub-period.

Table 4 *Descriptive statistics of stock market and exchange rate returns – EUR denominated*

	MSCI EMU - EUR	MSCI RO - RON	EURRON	MSCI RO - EUR
Overall period				
Mean return	-0.0012	-0.0023	-0.0004	-0.0017
Standard deviation	0.0213	0.0309	0.0063	0.0231
Skewness	0.0998	-2.6882	-0.3287	0.0786
Excess kurtosis	3.1768	27.1031	3.3202	2.9184
First sub-period				
Mean return	-0.0023	-0.0037	-0.0004	-0.0027
Standard deviation	0.0199	0.0241	0.0067	0.0218
Skewness	0.2304	-0.2896	-0.5590	0.1272
Excess kurtosis	6.1273	1.4269	3.2623	5.3747
Second sub-period				
Mean return	-0.0002	-0.0010	-0.0005	-0.0007
Standard deviation	0.0227	0.0365	0.0059	0.0244
Skewness	-0.0215	-3.2684	0.0024	0.0187
Excess kurtosis	1.4059	28.0825	3.3253	1.3449

In Table 5 and Table 6 we show the results of the analysis conducted over the two sub-periods, each split in ten periods of 20 observations (days), aiming at getting a glimpse at the performance of US dollar and euro investments as the crisis was unfolding. In the first sub-period, the mean returns were negative in six of the periods for an investment in MSCI US and positive in four periods, while being negative in seven out of ten and positive in three out of ten periods for an investment in MSCI Romania denominated in US dollars. The mean returns in the first sub-period ranged between -0.87% and 0.13% for MSCI US and between -1.26% and 0.21% for MSCI Romania, indicating a higher volatility for the investment in the Romanian capital market. This increased volatility may be also observed from the higher standard deviations of mean returns for all sub-periods in the case of the investment in MSCI Romania. Another observation that is worth mentioning refers to the RON-USD volatility, lower as compared to the Romanian stock market volatility for all sub-periods, which may indicate that the contribution of exchange rate risk to the risk of an investment in the Romanian market is smaller than the exchange risk itself.

Table 5 *Mean returns and standard deviations of stock markets and exchange rate – USD denominated*

	MSCI US-USD		MSCI RO - RON		MSCI RO - USD		USDRON	
	Mean return	*Standard deviation*	*Mean return*	*Standard deviation*	*Mean return*	*Standard deviation*	*Mean return*	*Standard deviation*
Sub-period 1								
Period 1	-0.0054	0.0132	-0.0126	0.0199	-0.0087	0.0144	-0.0035	0.0073
Period 2	0.0002	0.0125	0.0000	0.0246	0.0021	0.0172	0.0019	0.0081
Period 3	-0.0005	0.0184	0.0000	0.0280	0.0008	0.0210	0.0014	0.0080
Period 4	0.0022	0.0124	0.0033	0.0148	0.0056	0.0109	0.0034	0.0064
Period 5	0.0009	0.0078	0.0040	0.0138	-0.0007	0.0112	-0.0016	0.0084
Period 6	-0.0024	0.0112	-0.0027	0.0159	-0.0032	0.0107	-0.0008	0.0061
Period 7	-0.0030	0.0130	-0.0127	0.0219	-0.0005	0.0118	0.0024	0.0050
Period 8	0.0013	0.0140	0.0027	0.0224	-0.0020	0.0134	-0.0033	0.0103
Period 9	-0.0041	0.0174	-0.0082	0.0201	-0.0066	0.0185	-0.0025	0.0116
Period 10	-0.0087	0.0466	-0.0108	0.0424	-0.0126	0.0498	-0.0039	0.0176

	MSCI US-USD		MSCI RO - RON		MSCI RO - USD		USDRON	
	Mean return	*Standard deviation*	*Mean return*	*Standard deviation*	*Mean return*	*Standard deviation*	*Mean return*	*Standard deviation*
Sub-period 2								
Period 1	-0.0076	0.0457	-0.0064	0.0347	-0.0126	0.0541	-0.0050	0.0219
Period 2	0.0011	0.0455	-0.0019	0.0132	0.0027	0.0477	0.0016	0.0145
Period 3	0.0011	0.0187	-0.0125	0.0716	-0.0006	0.0239	-0.0017	0.0194
Period 4	-0.0010	0.0234	-0.0136	0.0283	-0.0042	0.0335	-0.0031	0.0154
Period 5	-0.0088	0.0280	-0.0109	0.0364	-0.0102	0.0296	-0.0014	0.0085
Period 6	0.0064	0.0246	0.0159	0.0338	0.0096	0.0305	0.0032	0.0122
Period 7	0.0044	0.0184	0.0103	0.0324	0.0054	0.0209	0.0010	0.0107
Period 7	0.0017	0.0168	0.0047	0.0320	0.0037	0.0169	0.0020	0.0086
Period 8	-0.0021	0.0128	-0.0034	0.0222	-0.0030	0.0160	-0.0009	0.0089
Period 9	0.0054	0.0111	0.0082	0.0243	0.0070	0.0144	0.0017	0.0058
Period 10	-0.0076	0.0457	-0.0064	0.0347	-0.0126	0.0541	-0.0050	0.0219

For a euro-based investor, we found six periods of negative mean returns in the first sub-period and four positive for an investment in MSCI EMU and in MSCI Romania denominated in euro. In the second sub-period the mean returns were negative in six periods and positive in four for MSCI EMU, but negative in seven periods and positive in three for MSCI Romania. The returns ranged between -0.93% and 0.35% for MSCI EMU and between -0.95% and 0.55% for MSCI Romania in the first sub-period, and between -0.93% and 0.59% for MSCI EMU and between -0.98% and 0.72% for MSCI Romania in the second period. As in the case of the US dollar investments, the returns provided by the Romanian market were more risky as the ones in MSCI EMU in both sub-periods and for all periods. Also, the standard deviation of the RON-EUR exchange rate was lower for all periods than the standard deviation of the returns in the Romanian market.

Table 6 *Mean returns and standard deviations of stock markets and exchange rate – EUR denominated*

	MSCI EMU - EUR		MSCI RO - RON		MSCI RO - EUR		EURRON	
	Mean return	*Standard deviation*	*Mean return*	*Standard deviation*	*Mean return*	*Standard deviation*	*Mean return*	*Standard deviation*
Sub-period 1								
Period 1	-0.0093	0.0177	-0.0126	0.0199	-0.0132	0.0180	-0.0035	0.0083
Period 2	0.0029	0.0199	0.0000	0.0246	0.0042	0.0215	0.0014	0.0061
Period 3	-0.0037	0.0164	0.0000	0.0280	-0.0046	0.0215	-0.0008	0.0075
Period 4	0.0035	0.0132	0.0033	0.0148	0.0055	0.0127	0.0021	0.0049
Period 5	0.0011	0.0080	0.0040	0.0138	0.0001	0.0106	-0.0010	0.0051
Period 6	-0.0041	0.0094	-0.0027	0.0159	-0.0045	0.0111	-0.0003	0.0045
Period 7	-0.0043	0.0163	-0.0127	0.0219	-0.0031	0.0194	0.0012	0.0047
Period 8	0.0016	0.0125	0.0027	0.0224	0.0019	0.0117	0.0003	0.0058
Period 9	-0.0032	0.0173	-0.0082	0.0201	-0.0041	0.0198	-0.0010	0.0049
Period 10	-0.0076	0.0440	-0.0108	0.0424	-0.0095	0.0455	-0.0019	0.0114
Sub-period 2								
Period 1	-0.0066	0.0387	-0.0064	0.0347	-0.0074	0.0441	-0.0009	0.0108
Period 2	0.0005	0.0340	-0.0019	0.0132	-0.0003	0.0345	-0.0008	0.0098
Period 3	0.0006	0.0131	-0.0125	0.0716	-0.0030	0.0150	-0.0036	0.0060
Period 4	-0.0024	0.0204	-0.0136	0.0283	-0.0027	0.0230	-0.0004	0.0055
Period 5	-0.0093	0.0251	-0.0109	0.0364	-0.0098	0.0259	-0.0005	0.0029
Period 6	0.0060	0.0197	0.0159	0.0338	0.0072	0.0193	0.0012	0.0031
Period 7	0.0051	0.0160	0.0103	0.0324	0.0057	0.0167	0.0006	0.0054
Period 7	0.0013	0.0149	0.0047	0.0320	0.0003	0.0160	-0.0010	0.0029
Period 8	-0.0029	0.0158	-0.0034	0.0222	-0.0028	0.0170	0.0000	0.0023
Period 9	0.0059	0.0118	0.0082	0.0243	0.0059	0.0121	0.0000	0.0021
Period 10	-0.0066	0.0387	-0.0064	0.0347	-0.0074	0.0441	-0.0009	0.0108

Apart from the values of standard deviations for Romanian market returns compared to the US market or euro-zone returns, we were interested, as mentioned in Section 4, in investigating the effective contribution that the volatility of the RON exchange rate fluctuations has on the Romanian returns denominated in US dollars and in euro, respectively. As indicated by equation (8), the proportion of Romanian market volatility explained by changes in the RON exchange rate depends not only on the volatility in the foreign exchange market, but also on the covariance between the Romanian market returns and exchange rate changes. Ultimately, the contribution of exchange rate volatility to the risk of a foreign investor in the Romanian market depends on the ratio between the covariance and the variance of exchange rate changes: when the covariance is negative and higher in value than the variance of the exchange rate changes, the foreign exchange risk has a negative contribution to the overall risk, thereby reducing the risk in US dollars or euro from an investment in Romania. Table 7 shows the values for the parameter λ for the US dolar based and the euro based investor for the overall period and for each of the ten periods in the two-subperiods. As we may observe, λ takes negative cases for all periods, with very few exceptions: in Period 9 in the first sub-period, in Periods 1, 2, 4 and 10 for the US dollar analysis and in Periods 1, 2 and 10 for the euro analysis in the second sub-period.

Graphically, Figure 8 shows the values for the λ parameter fluctuating around zero for all sub-periods, with the significant negative value in both US dollars and euro terms in Period 3 in the second sub-periods. Over both sub-periods and the entire periods, the exchange rate risk did not add to the risk of the domestic investment but, due to high negative values of the covariance, it decreased the risk that a US dollar or a euro based investor was exposed to from an investment in the Romanian market.

Table 7 *Lambda (λ) parameter values*

	λ – USD analysis	λ – EUR analysis		λ – USD analysis	λ – EUR analysis
Overall period	-0.3238	-0.7945			
Sub-period 1	-0.2838	-0.2258	*Sub-period 2*	-0.3420	-1.2481
Period 1	-0.9261	-0.2285	Period 1	0.5881	0.3799
Period 2	-1.0349	-0.3093	Period 2	0.9231	0.8530
Period 3	-0.7791	-0.6966	Period 3	-7.9979	-21.9442
Period 4	-0.8359	-0.3450	Period 4	0.2835	-0.5136
Period 5	-0.5036	-0.6877	Period 5	-0.5084	-0.9768
Period 6	-1.2014	-1.0650	Period 6	-0.2277	-2.0723
Period 7	-2.4193	-0.2756	Period 7	-1.4096	-2.7701
Period 7	-1.7922	-2.6534	Period 7	-2.5895	-3.0271
Period 8	-0.1781	-0.0322	Period 8	-0.9153	-0.6996
Period 9	0.2742	0.1310	Period 9	-1.8427	-3.0577
Period 10	-0.9261	-0.2285	Period 10	0.5881	0.3799

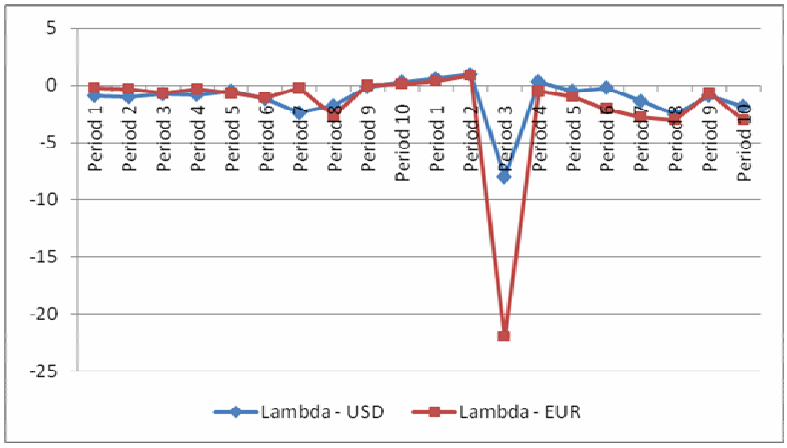

Figure 8 *Lambda values – USD versus EUR comparison*

As an international investor is interested in diversification of his asset holdings, it is relevant to analyze the contribution of exchange rate risk to the correlation between the Romanian market and the home market of the investor. The parameter φ, defined in Equation (10) shows the contribution of exchange rate volatility to the correlation between the two markets; the computation of this parameter for our analysis is presented in Table-10. As indicated by Equation (10), the parameter value depends on the correlation between the Romanian market returns with the change in the exchange rate of the RON against the US dollar and the euro, and the ratio between the exchange rate volatility and the volatility of the Romanian market return denominated in US dollars and euro. As in the case of λ, we observe the evolution of φ for the entire period, the two sub-periods and each of the ten intervals in the sub-periods.

Table 8 shows the computations of the correlations between the exchange rates of the RON against the US dollar and euro and the MSCI indices for the home countries of investors (MSCI US and MSCI EMU), on one hand, and the correlations between the MSCI US and MSCI EMU and the MSCI Romania index denominated in US dollars and euro, respectively. The computations are performed for the overall period, for the two sub-periods and for ten periods within each of the two sub-periods. For both US dollar and the euro, there is striking difference between the correlations involving the exchange rates and the ones involving only the stock market indices. A couple of observations are noteworthy. First, the correlations in columns (1) and (4) are lower and much lower than the correlations in columns (2) and (5): from the US dollar perspective, the correlation between the RON-USD exchange rate and MSCI US is 0.0598 for the overall period, but it is negative for the first sub-period (-0.0547) and positive for the second sub-period (0.1182), while the correlation between MSCI US and MSCI Romania is 0.9007 for the overall period and is also very high for the two sub-periods (0.8912 for the first one and 0.9058 for the second one); from the euro perspective, the correlations between the RON-EUR exchange rate and MSCI EUR is 0.1413 for the overall

period, and is also positive for the two sub-periods (0.1214 and 0.1654, respectively), but the correlations between stock market indices are close to 1: 0.9631 for the overall period and 0.9525 for the first sub-period and 0.9713 for the second sub-period. Second, all correlations vary in time, regardless of the sub-period and the currencies involved: from the US dollar perspective, the correlations involving the exchange rate vary between -0.4814 and 0.3827 and the ones involving stock market indices vary between 0.6077 and 0.9585; from the euro perspective, correlations vary between -0.3628 and 0.5730 when the exchange rate is involved, and between 0.8896 and 0.9878 for stock market indices. Third, when we contrast the correlations between the RON-USD exchange rate and MSCI US (column (1)), on one hand, and the correlations between the RON-EUR exchange rate and MSCI EMU (columns (2)), on the other hand, we find a lower number of negative correlations in column (4) and, on average, higher values for these correlations, which is in indicator of the closer link between the Romanian economy and the euro-zone economy.

Table 8 *Stock market and exchange rate correlations and phi*

	Correlations – USD investor			**Correlations – EUR investor**		
	USDRON to MSCI US - USD	**RO - USD to MSCI US - USD**	**Phi (φ_{USD})**	**EURRON to MSCI EMU - EUR**	**RO - EUR to MSCI EMU - EUR**	**Phi (φ_{EUR})**
	(1)	(2)	(3)	(4)	(5)	(6)
Overall period	0.0598	0.9007	0.0289	0.1413	0.9631	0.0400
Sub-period 1	-0.0547	0.8912	-0.0279	0.1214	0.9525	0.0392
Period 1	-0.1119	0.8690	-0.0653	-0.1503	0.9000	-0.0774
Period 2	0.3565	0.8972	0.1878	0.1112	0.9598	0.0327
Period 3	0.1292	0.9255	0.0533	0.5489	0.9563	0.2009
Period 4	-0.4814	0.8575	-0.3295	-0.2851	0.9305	-0.1171
Period 5	-0.0321	0.6696	-0.0356	0.2934	0.8896	0.1576
Period 6	-0.3466	0.8455	-0.2334	0.1503	0.9139	0.0675
Period 7	-0.4077	0.9234	-0.1855	0.5730	0.9801	0.1415
Period 8	-0.4237	0.7174	-0.4543	-0.3628	0.8896	-0.1999
Period 9	-0.2302	0.7936	-0.1813	0.4143	0.9748	0.1041
Period 10	-0.0037	0.9352	-0.0014	0.0065	0.9678	0.0017
Sub-period 2	0.1182	0.9058	0.0557	0.1654	0.9713	0.0410
Period 1	0.1792	0.9169	0.0793	0.3903	0.9741	0.0985
Period 2	-0.0066	0.9526	-0.0021	-0.0961	0.9594	-0.0284
Period 3	-0.2130	0.6077	-0.2849	0.0990	0.9175	0.0431
Period 4	0.4643	0.9129	0.2345	0.3809	0.9749	0.0940
Period 5	0.0418	0.9585	0.0124	0.2099	0.9942	0.0233
Period 6	0.2878	0.9233	0.1250	-0.2116	0.9878	-0.0341
Period 7	-0.0478	0.8577	-0.0287	-0.0357	0.9453	-0.0123
Period 8	-0.2387	0.8703	-0.1391	0.2823	0.9848	0.0519
Period 9	0.0697	0.8338	0.0462	0.4636	0.9927	0.0637
Period 10	0.3827	0.9283	0.1659	0.0590	0.9853	0.0102

When we investigate the parameter φ (columns (3) and (6)), we observe its low values, close to zero, for the overall period, the two sub-periods and the twenty smaller periods. This suggests that the contribution of exchange rate risk to the risk of an international investor diversified in his home market and the Romanian market is small, in some periods even negative – in these periods, exchange rate risk, instead of increasing the overall risk of the portfolio, it diminishes it through the

impact of the negative correlation between the exchange rates and the investor's home index. Still, as φ values are variable in time, the contribution of exchange rate risk to the overall portfolio has to be strictly monitored, since past values are not a reliable proxy for its future values. When comparing the two sub-periods, no significant differences emerge between our results, which suggests that in times of crisis the impact of exchange rate risk in an international portfolio is not altered compared to "normal" times: this is the effect of the change in correlations between the exchange rate and the stock market indices, along with the changes in the correlations between stock market indices.

CONCLUSIONS

Our paper investigates the impact of changes in the Romanian currency – leu – exchange rates against the US dollar and the euro on an investment in the Romanian stock market from the perspective of a US dollar and euro based investor. Our analysis is directed towards identifying the significance of exchange rate volatility on the total risk of a Romanian investment from the point of view of two potential investors having the US dollar and the euro as reference currencies. At the same time, we aim at discovering the contribution that currency risk makes to the correlation between the Romanian stock market returns, on one hand, and US market and European markets, on the other hand. We use daily data on stock indices and exchange rates and employ three stock market indices, to capture the performance of the Romanian market, the US market and the European market: MSCI US, MSCI EMU and MSCI Romania. The analysis covers the period starting on December 26, 2007 and ending on August 4, 2009. The period is split in two equal parts around the date of October 15, 2008, considered the day when the current financial crisis intensified. The day was chosen as it recorded the largest daily drop in the value of the MSCI US index since 1999. The analysis on these two sub-periods allows us to observe into more detail whether in times of financial instability the importance of currency risk for an international investor changes as compared to more stable periods. Each of the two sub-periods in again split in ten equal intervals of 20 observations, aiming at studying the time-varying attributes of stock market returns and risks, currency volatility and correlations.

Our results indicate that during more turbulent times, as the ones recorded in the second sub-period, investors were better off if invested in their home markets, as compared to the Romanian market, when they are also hit by changes in the exchange rates: the mean returns of home indices are higher than the ones provided by an investment in MSCI Romania, while the standard deviations of these returns are smaller.

The contribution of exchange rate volatility to the risk of a foreign investor in the Romanian market depends on the ratio between the covariance and the variance

of exchange rate changes: when the covariance is negative and higher in value than the variance of the exchange rate changes, the foreign exchange risk has a negative contribution to the overall risk, thereby reducing the risk in US dollars or euro from an investment in Romania. We find that over both sub-periods and the entire period, the exchange rate risk did not add to the risk of the domestic investment but, due to high negative values of the covariance, it decreased the risk that a US dollar or a euro based investor was exposed to from an investment in the Romanian market.

As an international investor is interested in diversification of his asset holdings, it is relevant to analyze the contribution of exchange rate risk to the correlation between the Romanian market and the home market of the investor. We find that the contribution of exchange rate risk to the risk of an international investor diversified in his home market and the Romanian market is small, in some periods even negative – in these periods, exchange rate risk, instead of increasing the overall risk of the portfolio, it diminishes it through the impact of the negative correlation between the exchange rates and the investor's home index. Still, as φ values are variable in time, the contribution of exchange rate risk to the overall portfolio has to be strictly monitored, since past values are not a reliable proxy for its future values. When comparing the two sub-periods, no significant differences emerge between our results, which suggests that in times of crisis the impact of exchange rate risk in an international portfolio is not altered compared to "normal" times: this is the effect of the change in correlations between the exchange rate and the stock market indices, along with the changes in the correlations between stock market indices.

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